Technical Report 1308

The Importance of Cognitive Factors that Guide Escalation of Force Decisions

Christopher L. Vowels
U.S. Army Research Institute

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United States Army Research Institute for the Behavioral and Social Sciences

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14. ABSTRACT *(Maximum 200 words)*:
The purpose of this report is to explore previous models of Escalation of Force (EOF) and provide a revised model based on pre-decisional cognitive factors that influence Soldiers' decisions prior to engagement in escalation procedures. Previous models were largely reactive, assuming that Soldiers' ability to make decisions was constant across situations (e.g., regardless of cognitive workload or other operational conditions). The proposed pre-decisional space model takes a cognitive-perceptual perspective and focuses on factors that influence information processing. This information processing leads to judgments and decisions occurring prior to engagement in escalation procedures. Further, two previous U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) avenues of research, specifically training on nonverbal behavior and on military judgment proficiency, are recommended as viable approaches to assess the validity of the pre-decisional space model and as effective approaches for enhancing Soldier capabilities in EOF situations.

15. SUBJECT TERMS

Escalation of Force (EOF), Rules of Engagement (ROE), threat detection, irregular warfare

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THE IMPORTANCE OF COGNITIVE FACTORS THAT GUIDE ESCALATION OF FORCE DECISIONS

EXECUTIVE SUMMARY

Research Requirement:

The Army is faced with conducting major combat operations (MCO) and counterinsurgency operations (COIN) in an evolving and irregular operational environment. Many missions require Soldiers to operate in close proximity to local citizens and engagement with local citizens can affect overall Army initiatives to win the hearts and minds of the local populace. Rules of Engagement (ROE) and Escalation of Force (EOF) procedures guide Soldiers' posture and behavior in interactions with citizens of a local populace as well as (potential) combatants. As the Army mission has continued to encompass operations other than war (OOTW), the necessity to establish effective procedures for engaging with noncombatants and (potential) combatants has become critical. A research program that explores the psychological mechanisms and processes necessary for decision-making in EOF situations can provide needed understanding to enhance those requisite decisions.

Procedure:

Academic and military literatures were reviewed as well as popular press sources that related to EOF situations pertaining to cognitive factors that could influence those situations. Information was gathered from foundational and current psychological theories as well as from contemporary military sources. Previous EOF models were reviewed and a new model, based on these previous models and on contemporary findings from psychological science, was constructed.

Findings:

Previous models involving EOF assumed that decisions to escalate were based on observations of overt events in the environment, such as threatening actions of potential combatants, without considering the information processing occurring at perceptual and cognitive levels. The models reviewed (Traditional, Threat Assessment Process, and Ability, Opportunity, Risk of Serious Injury) assumed that Soldiers would be able to respond equally effective in EOF situations regardless of conditions (e.g., cognitive workload, operations during dark hours) and largely assumed that Soldiers would necessarily enter into escalating procedures without considering factors influencing how they may be interpreting the situation. Based on the review of academic and military literatures, a pre-decisional space model is presented that takes into account the significance of the observer-environment relationship, especially cognitive factors likely to influence judgments and decisions in EOF scenarios. The model proposed is preventative in that it focuses on information processing and the way in which judgments are formed prior to the actual decision to escalate force in a given situation. This model focuses on the perceptual and cognitive processes taking place prior to the decision to escalate, rather than the processes following the decision to escalate.

Utilization and Dissemination of Findings:

The findings in this report could be used to establish a research program for studying the cognitive and environmental factors that impact Soldiers' judgments and decisions in EOF situations. Likewise, previous U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) research involving nonverbal behavior and military judgment proficiency could serve as practical means for enhancing Soldier skills and for assessing the concepts in the pre-decisional space model.

THE IMPORTANCE OF COGNITIVE FACTORS THAT GUIDE ESCALATION OF FORCE DECISIONS

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"Asymmetrical threats are most likely to be based in urban areas to take advantage of the density of civilian population and infrastructure."

Field Manual (FM) 3-06.11, *Combined Arms Operations in Urban Terrain*

"…we will not win based on the number of Taliban we will kill, but instead on our ability to separate insurgents from the center of gravity – the people."

General Stanley McChrystal (ret.),
Former ISAF CDR, Afghanistan
Tactical Directive, July 6, 2009

Introduction

A requisite warrior task that Soldiers must learn is to assess and respond to threats from potential combatants in accord with established Escalation of Force (EOF)[1] procedures. These skills are extremely important for contemporary operations, since most operations take place within and around a local civilian population. However, "The human dimension…is potentially the most important and perplexing for commanders and their staffs to understand and evaluate" (*Civil Disturbance Operations,* FM 3-19.15). Commanders must dictate the appropriate use of force and/or restraint in a given area of operations (AO). Likewise, Soldiers working within and around a local population must follow those orders and make critical decisions involving appropriate use of force. Soldiers are expected to defend and protect with lethality and, yet, also portray themselves as sociable, political ambassadors. This dual role is no easy task especially for Soldiers in the operational environment (OE).

Soldiers must make decisions that could concomitantly protect their fellow Soldiers and also end the life of another human being. Such situations may be full of uncertainty. Dealing with uncertainty is something with which our species has evolved. Nevertheless, some psychological research has shown that we are susceptible to a number of natural biases that may negatively influence our decision-making (Ariely, 2008; Kahneman & Tversky, 1979; 1996; Wolfe & van Wert, 2010). Yet, other research has shown that evolutionary pressures forced development of cognitive mechanisms that allow us to make rapid and accurate interpretations of our environments (Gigerenzer & Todd, 1999; Gigerenzer, 2008). Soldiers have to be able to deal with uncertainty and interpret their visual environment effectively especially when trying to interpret the behavior of others.

If Soldiers are conducting counterinsurgency (COIN) operations, they are required to work in and around a local population (see Abbe, 2008; Fite, Breidert, & Shadrick (2009); Zbylut et al., 2009). However, "The urban environment is not neutral – it helps or hinders" (FM 3-19.15). Thus, increasing the number of Soldiers close to a local population requires a sensitivity to "win the hearts and minds" of those citizens. As illustrated in Center for Army Lessons Learned (CALL) interviews, training involving rules of engagement (ROE) was a

[1] The Appendix contains a list of the acronyms used in this report.

paramount concern for some Brigade Combat Team (BCT) Commanders (CDRs).[2] For example, by the time of one unit's arrival in theater, the situation had changed and new Tactics, Techniques, and Procedures (TTP) involving the use of lethal force had to be created and then trained to all unit Soldiers.

Field Manual 3-24, *Counterinsurgency* and Joint Publication (JP) 3-24, *Counterinsurgency Operations* indicate that CDRs must continuously evaluate the ROE in their respective OEs. The ROE guide when a Soldier may react with appropriate force. "They may fire when they positively identify a member of a hostile force or they have clear indications of hostile intent" (FM 3-24). However, even when hostile intent is clearly identified, Soldiers may hesitate to engage with force due, for instance, to not being able to accurately identify the enemy or due to the enemy's close proximity to the local civilian population (CALL 2007; 2009). The problem becomes one of determining where to draw the line and allow Soldiers to execute their trained skills of combat and when to withhold their actions for the greater purpose of the overall Army mission.

All of the tenets imbedded in the Law of War (Department of Defense [DoD], 1998) are important and two are most relevant for the present report. Specifically, these are (a) Soldiers and Marines fight only enemy combatants and (b) Soldiers and Marines treat all civilians humanely. Unfortunately, Soldiers are in situations where the civilian population may not always adhere to the same guidelines and/or they may unexpectedly change their attitude towards Coalition Forces (CF). Although the United States has operated in the current theaters of operation for almost a decade, local civilians may not always heed warnings or respect the rules put in place to protect them. Soldiers are trained to take a number of steps to inform local citizens and/or potential combatants to avoid a location CFs are occupying to include: audible warnings, such as horns and sirens, visual warnings, such as flashlights and flares, and demonstration of weapons and intent to use them, such as warning shots and/or disabling shots (CALL, 2009). Such procedures were created to diminish the threat to noncombatants of being mistaken for combatants by CF and to provide opportunities for Soldiers to better assess their situation.

Further, as noted in FM 3-24, local Iraq and Afghanistan village occupants Soldiers have worked with in the past may take up arms against CF when ordered to do so and/or at random for more basic needs (i.e., money, protection of their families, etc.). Likewise, Soldiers are operating in areas (especially Afghanistan) where multiple and different militant Islamist sects are operating and not always in a unified manner. Further, due in large part to influences, such as the Taliban and al Qa'ida, much of the normal Afghan social order across myriad regions of Afghanistan has been undermined (Kilcullen, 2009). All of the above make simply identifying and engaging the enemy an extremely difficult task.

In one of General McChrystal's assessments from the end of July, 2009, he listed "Civilian Casualties, Collateral Damage, and Escalation of Force" as major topics of consideration. He proposed a surge strategy, currently underway, much like the one used in Iraq under General Petraeus's watch. General McChrystal indicated that a significant portion of

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[2] For a more thorough analysis and useful depiction of numerous topics covered in these interviews, refer to Fite and Shadrick (in preparation).

casualties have occurred during EOF procedures and usually occur in units who have received less training and have inferior unit cohesion. Adding a surge of troops increases the likelihood of such units operating in Afghanistan. He partly noted that high illiteracy rates and cultural differences could explain why many Afghan civilians have not heeded the EOF warnings in the past. General McChrystal recommended that pre-deployment training was needed to improve the judgment of Soldiers and to provide EOF guidance for Soldiers working in close proximity to civilians. Even though the new procedures were criticized, the ultimate purpose was to protect noncombatants, while maintaining Soldiers' access to appropriate force for use against identified combatants (Johnson, 2010).

Even after years of war, changes to standing ROE (SROE) and EOF do occur and cause Soldiers to hesitate on which procedures they have authority to utilize.[3] The topic of U.S. Army Soldier EOF engagements with the local civilian population has been enough to warrant the consideration of a medal for troops exhibiting restraint during EOF interactions with civilians (CNN, May 12, 2010). In contrast, some engagements have ended with Soldiers being charged with murder and imprisoned (Mestrovic, 2008). As contended by General Chiarelli, the Army is now required to concurrently, and at cost, conduct and promote stabilization as well as conduct major combat operations (MCO) (Bernton, 2010). Thus, the Army is tasked with being lethally effective and politically effective, even at the level of the individual Soldier.

The bigger picture is to protect the local population while winning the wars in Iraq and Afghanistan. Whether surges are good military strategy or not, more Soldiers on the ground means a higher likelihood of lack of adherence to ROE and EOF procedures by civilians and a higher potential for civilian casualties. Further, as those AOs change so too will the SROE; moreover, changes in SROE may increase the likelihood that Soldiers will hesitate in potential EOF situations. Despite current rhetoric across the Army to shift training back to focus more on MCO, at the cost of continuing to train for COIN, COIN operations will continue to be a requirement for contemporary and future OEs. The policies established about how the Army engages local citizens in the current theaters of operation will also be important in future Army efforts that will continue to require a population-centric approach, such as in many of the 53 countries in Africa. A psychological research initiative examining how Soldiers enforce EOF procedures as well as adapt to changes in those steps could inform both individual and collective tasks involving population engagement. Specifically, an examination of these procedures will likely better inform when and why effective measures are used and also how and why procedures breakdown from a cognitive perspective.

As demonstrated above, Soldiers are operating in a dynamic decision environment that requires rapid choices with the consequences of those choices being significant. Although guidelines assist in making those difficult decisions, the uncertainty endemic to the OE consistently makes EOF decisions challenging. The decision maker, whose information processing and decisions may suffer from the result of natural biases, is likewise tested to make accurate interpretations and decisions across a variety of conditions. In this report, some

[3] ROE and EOF procedures may change in an AO across a unit's deployment, because conditions within that area may change (get better or worse). Thus, a commander must make the decision of what procedures make the most operational sense for the unit at that time. Refer to Appendix D, FM 3-24.

operational EOF events are discussed that depict the arduous nature of decisions in those situations. Following this, several EOF models are reviewed and a revised model is proposed. The proposed model demonstrates the importance of the interaction between the observer and the environment and the major cognitive factors that can affect information processing prior to EOF decisions. Once the major tenets of the model are laid out, two ARI research efforts are discussed. These research efforts, involving non-verbal behavior and judgment proficiency, are useful because they would allow some of the assertions made in the model to be tested; the research could also assist in training effective behavior for EOF situations. Finally, some related psychological theories are reviewed to reveal further opportunities to test information processing notions illustrated in the proposed model.

EOF Incidents

The initial purpose of EOF procedures was to provide Soldiers with a sequence of increasingly elevated actions that could assist them in making appropriate responses to potentially threatening situations. The EOF procedures have had to change to allow Soldiers to function effectively in contemporary OEs. These changes, however, have not always had the desired effects. In some situations, Soldiers under direct fire have hesitated to return fire because they cannot get positive identification (PID) [4] of the enemy (CALL, 2007; 2009). Although engaging the local population according to SROE is the operational expectation, it has been noted that some units have had difficulty acquiring full EOF kits[5] while deployed (CALL, CDR Interviews, March 2010).

Previous focus from International Security Assistance Force –Afghanistan (ISAF newsletter, February, 2010) has clearly indicated the importance of EOF in continued operations in Afghanistan. An incident noted in an ISAF newsletter reveals the importance of several factors and it is briefly recounted below. Though random events can certainly influence situations, in this case many variables interacted to tip the situation towards an undesired outcome.

> In the hour just preceding this incident, a Soldier in the battalion had been killed by an Improvised Explosive Device (IED) when the vehicle he was in hit a pressure plate triggering the IED. While recovering the vehicle, the operation was approached by rapidly advancing motorcycles, whose lead driver failed to yield to warning signs issued by the occupying Soldiers. It resulted in the death of the 50-year old driver and 12-year old passenger. Just one day prior, combatants had tried to use a nearby location to emplace an IED. Further, information from that unit's S2 [Intelligence Officer] noted that attacks from combatants on motorcycles had a high probability. Only the day prior, members of the Afghanistan National Army had pursued combatants on motorcycles. Given the rapid approach of the

[4] Positive identification (PID) is the reasonable certainty that the object of the attack is a legitimate military target. Consider that attacks can occur during dark hours, the enemy has many varieties of weapons available, and the enemy usually has the advantage of the knowing the terrain (geographic and human) more intimately than our Soldiers. See CALL Handbook 07-21 (July, 2007).

[5] For an example of components of an EOF Kit, see CALL Handbook 07-21 (July, 2007, pgs. 62-76). Primarily, these kits include speakers/sirens, lasers, flashlights, and spike strips.

motorcycles, the Soldiers had to make a quick decision and had to do so at night. Further, the mission was planned for hasty vehicle recovery not as a vehicle control point (VCP); the situation prompted a revision to VCP procedures for Soldiers on foot patrol, which were found to be inadequate. The incident also reinforced the importance of ensuring all units have complete EOF kits for that and similar situations; the kit in use was found to be incomplete.

A publication of incidents involving direct-fire engagements cited the importance of EOF procedures when engaging the enemy (CALL, 2009). In each of those incidents (pp. 41-50), CF were engaged with direct fire and had to determine whether to engage the enemy. Two recurring "EOF Considerations" were (a) not being able to engage the target until PID is confirmed and (b) if the risk of collateral damage is too great, the enemy should not be engaged. One of the engagements occurred near dusk making PID more difficult and occurred within close proximity to a local village, a factor that complicated the engagement. Other incidents cited in the CALL handbook noted that villagers were not as open in their expressions to CF and this was a potential indicator of enemy presence.

As cited above, many EOF situations are ambiguous and require a predictive application of rules governing interaction with potential combatants. However, predictions are only best guesses about future states of the world, because complete certainty of the situation is not or cannot be known. As discussed next, several EOF models have been developed to provide the Soldier with a certain set of reactions or sequential steps of appropriate escalation to uncertain situations. However, EOF situations are all affected by subjective and malleable interpretation. Once the previous models are reviewed, a revised model is demonstrated that takes into account the cognitive factors that affect subjective interpretation in uncertain decision environments.

EOF Models

The models below were developed to assist Soldiers in making decisions about engaging potential threats in situations that could require graduating force to the point of lethality. These are briefly reviewed below in terms of their overall structure and their primary attributes. The traditional EOF model describes what to do if a Soldier suspects a situation may involve a potential threat. The Threat Assessment Process (TAP) model attempted to modify the procedures of the traditional model to allow Soldiers further opportunity to identify if a potential threat is indeed real. The Ability, Opportunity, Risk of Serious Injury (AOR) model describes what overt characteristics Soldiers need to consider (in order to escalate force). Of course, none of these models preclude a Soldier from immediately using the maximum force necessary in situations that clearly require it.

Traditional (Doctrine)

The traditional EOF process (Figure 1) includes four primary steps moving from least use of force and leading to the highest escalated force possible. The steps are: Shout, Show, Shove, and Shoot. In the shout step, the verbal or other audible warning is given to get the attention of the individual(s). Show is the act of demonstrating weapons and intent to use them. Shove involves both physical restraint of the individual and restraint of a given area. The Shoot step

involves firing warning, disabling, and finally a deadly shot at the threat. The traditional EOF process is a sequential set of reactions to Soldiers can use after recognizing either hostile intent or a hostile act.

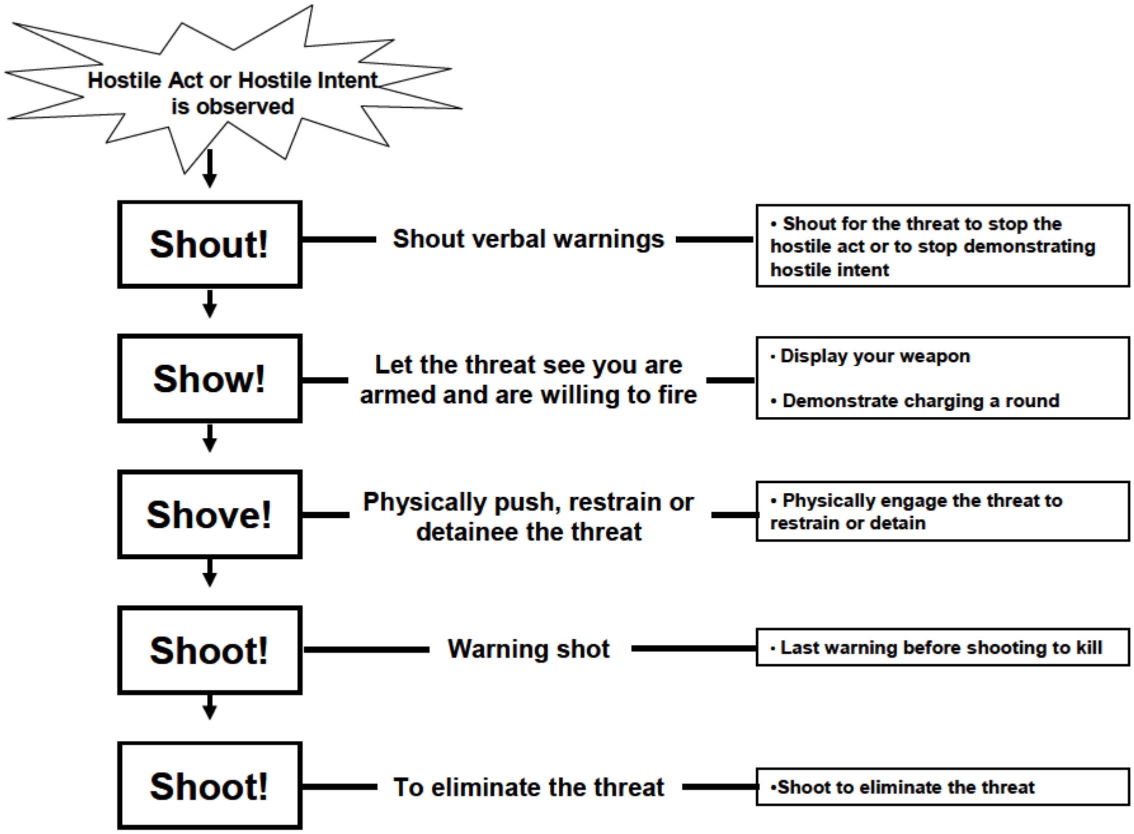

Figure 1. Depiction of the Traditional EOF process as illustrated in Bagwell (2008, pg. 6) showing the five steps of escalation in reaction to hostile intent or hostile act.

Though the traditional EOF procedures allow for use of a graduated force response to potential threats, they do not provide actions necessary to assist with identifying potential threats. It is a reactionary model not a preventative model. Soldiers have had to adapt their behavior according to the dynamic environments they are operating in. For example, the model discussed next is an example of a revision to the original EOF process aimed at providing more time to make a decision.

Threat Assessment Process (TAP)

The Threat Assessment Process or TAP, shown in Figure 2, is proposed as an evolved process beyond the traditional EOF procedures (Bagwell, 2008). Bagwell's model involves three primary steps: (a) get their attention, using either passive (e.g., signs, lights, etc.) or active (e.g., shouting, lasers, etc,) means, (b) communicate your commands, to ensure the person understands what s/he must do to avoid an escalated reaction from Soldiers, and (c) make the threat decision, by determining whether hostile intent or acts have been demonstrated. Bagwell argues that the TAP provides three imperative qualifications beyond traditional EOF procedures:

1) Gets the attention of persons who may be potential threats,
2) Communicates to these persons what they need to do to avoid the use of force against them, and most important for Soldiers, and
3) Provides Soldiers with time to make an informed threat decision.

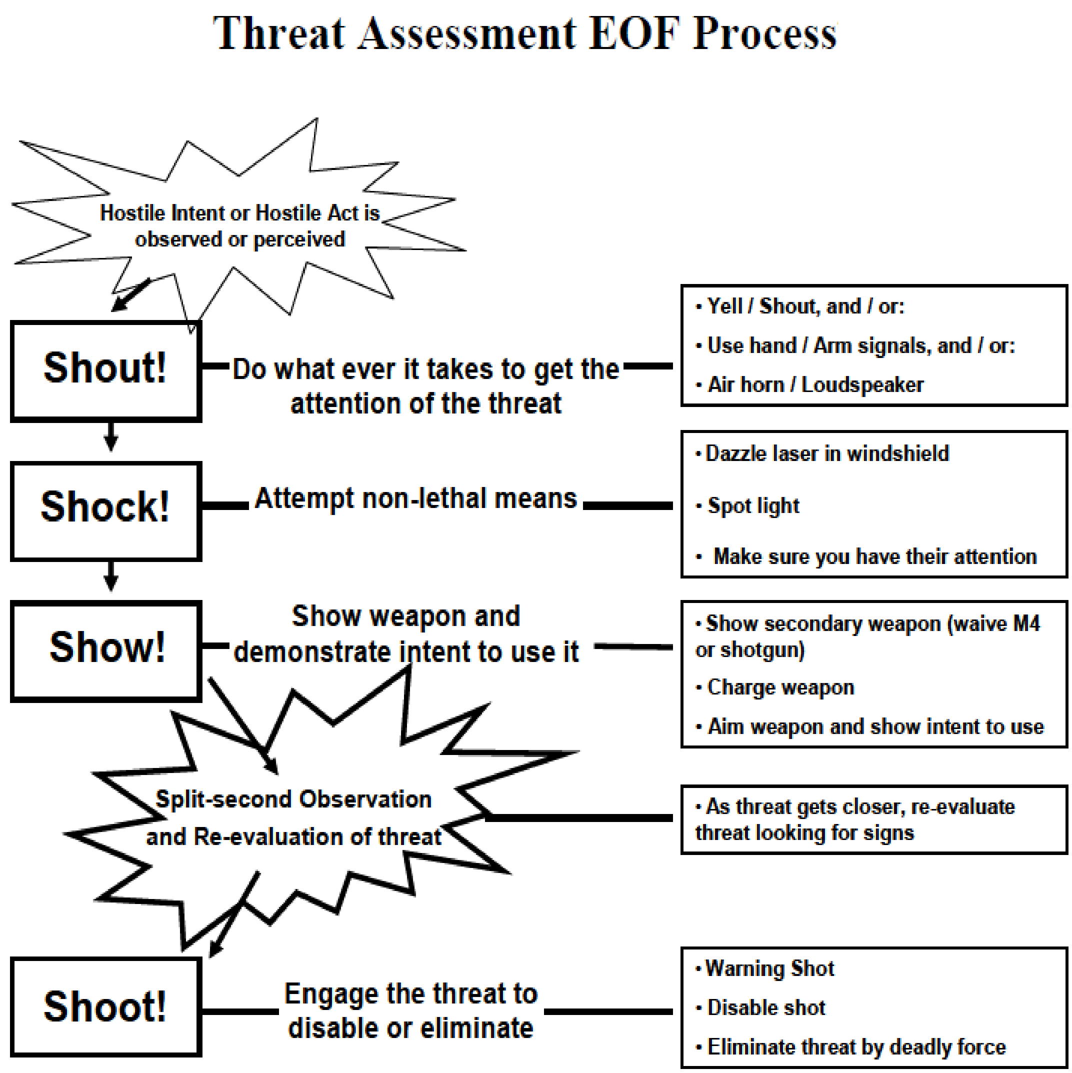

Figure 2. The Threat Assessment Process proposed by Bagwell (2008, pg. 10) depicting the four steps in reaction to observed or perceived hostile intent or hostile act.

Those qualifications are, however, present in the traditional EOF process. Nevertheless the TAP model does take advantage of more contemporary equipment additions, such as handheld or weapon-mounted lasers. The most important change is the delay of the threat decision until later in the process allowing more time (when possible) for the Soldier to assess a situation fully. Bagwell notes three primary factors which influence decisions involving potential threat, all of which are external to the Soldier. These include: (a) whether or not the

individual(s) comply with the Soldiers' commands, (b) the location of the individual(s) hands, and (c) whether the individual(s) behavior appears to grant the potential combatant an advantage.

Commonalities among the traditional EOF sequence and the TAP sequence include relying on a graduated process to include getting a potential combatant's attention that may be intent on causing harm to CF. However, Bagwell relies on distance as the determining factor for deciding between what he calls a potential versus an actual threat. As with the traditional EOF process, however, what he proposes fails to consider relevant, cognitive characteristics of the Soldier. Further, given the close proximity to the local population in which Soldiers often operate, it may not be possible to obtain adequate distance. The next model reviewed focused on characteristics of the situation that indicate potential threat, while using similar determining factors as the previous models, such as distance.

Ability, Opportunity, Risk of Serious Injury (AOR)

In previous ARI research, Lawlor and Lawlor (1999) proposed a model to also assist Soldiers in making decisions about whether a situation required an escalating response. They contended that the model assisted Soldiers in making decisions about when to use weapons, whereas the traditional training model only described behaviors for how to use weapons. Given this shift in focus to the decision making process, the models discussed have moved progressively closer to an analysis of the situation and closer to the importance of the Soldier as an information processor embedded in a dynamic decision environment.

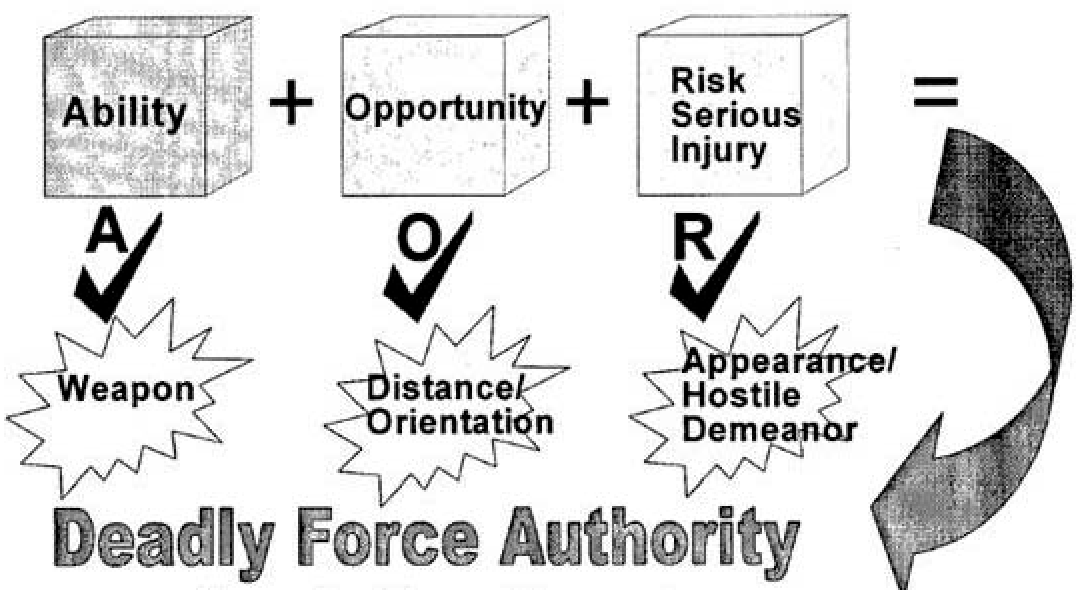

Figure 3. The AOR process proposed by Lawlor and Lawlor (1999, pg. 13) indicating the maximum use of force when all elements are present in a given situation.

Their model involved three "elements" that were cumulative, such that all three had to be met in order to respond with deadly force (Figure 3). These elements included: (a) ability – whether the civilian has the ability to inflict harm; (b) opportunity – if the civilian has the opportunity to inflict harm; (c) risk of serious injury – whether the Soldier or fellow Soldiers are

at a high risk of injury from the suspected civilians. These "elements" also involved determinants which served as broad indicators/cues that could verify if that particular element was indeed present. These included presence of a weapon for the Ability element; a weapon was defined as anything that could be used to inflict harm. The next was Distance and/or Orientation for the Opportunity element. If the civilian is close enough and has the weapon oriented in such a way as to be perceived as aimed in a threatening manner, it was considered an opportunity. The final was Appearance and/or Threatening Demeanor for the Risk element which involved whether the civilian was exhibiting verbal or nonverbal behavior indicative of hostile intentions/actions. Within this last determinant were six "situational cues" that could influence how a Soldier interprets whether a hostile intent or hostile act is being presented. These included such items as the physical size of the threat (person) in relative size to the Soldier, whether a Soldier was outnumbered, and the Soldier's mission. The last item is particularly important, because it relates closest to one of the cognitive factors (*Top-down influences/Goals*) discussed in the following section.

As effective as the AOR model was at attempting to create standard rules for Soldiers to use across operational situations, it did not take into account cognitive factors (e.g., causal inferences). "Situational cues" are noted, but the AOR model places the key phase of determining hostile appearance or demeanor last in the sequence. The situational cues were focused on the mechanical aspects of the potential threat not the cognitive factors influencing how a Soldier may initially interpret the threat.[6]

Cognitive Factors and the Pre-decisional Space Model

The models discussed have focused largely on reactionary procedures, but the following factors and proposed model are important for the period preceding the critical event, particularly with respect to interpreting the situation. The EOF situations are more complicated than observed hostile intents/acts behavior or the engagement of standardized procedures in reaction to those observations. The models discussed previously all largely ignored cognitive-perceptual influences that would affect the subjective interpretation of whether a person(s) and/or object (e.g., vehicle) is indeed threatening. The previous models also assumed that Soldiers will be equally ready to make decisions across situations and are immune to internal and external influences. Bagwell, for instance, notes that the threat decision "depends on the independent and sound judgment of the Soldier" (pg. 12) but does not go much further in his analysis. The factors included here provide more of the why or the influences that make original interpretation of a situation difficult even before a process of graduated force is initiated.

A research and training program for EOF cannot be optimally effective or provide useful recommendations for the human dimension without rooting itself in psychological theory and contemporary research findings. Simon (1957) contended that the processing of information and the decisions made about that information are contingent upon the inherent, processing limitations of human beings. Human beings cannot possibly process all available options in complex situations, at least not consciously; because of these limitations, we engage in matching processes between present situations and past experiences (Klein, 1998). What is missing from

[6] The AOR model further failed to take into account cultural and regional characteristics that could influence interpretation.

the models already reviewed is an understanding of the cognitive factors in the human observer that are the primary influences on interpretation and decision-making.

At least six factors of cognitive relevance are influential in EOF situations and these are discussed in turn (see Table 1). The table is not exhaustive, but it is based on current psychological research and reported EOF incidents. The factors were determined to be the primary influences on interpretation in most EOF situations. All of these factors affect how Soldiers process and react to their visual environment. Their influence on cognition determines if a visual environment is interpreted as threatening or non-threatening. The model includes three factors that are internal to the observer (proportionality, top-down influences, and causal inferences) and three environmental factors (natural changes, informational switch, and time pressure). These factors are discussed to demonstrate the importance of the observer-environment relationship and, as discussed later, the significance of the pre-decisional space. The pre-decisional space is the mental space where these factors are represented and exert influence on interpretations and decisions. Although the environmental factors are outside the observer, each are still processed and mentally represented by the observer; other relevant situational characteristics may include cognitive workload and experience. All of these elements are important as they influence whether or not a Soldier will detect an actual threat amongst many potential threats, not just react to them as illustrated in the EOF models discussed previously.

Table 1

Primary Cognitive Factors

Brief Descriptions of the Primary Cognitive Factors that Mitigate Decisions in the Pre-decision Environment

Cognitive Factor	Description
Observer	
Proportionality	- The representation of information of occurrences and non-occurrences of events.
Goals (Top-down Influences)	- Organize thought patterns and direct information processing pathways.
Causal Inference/Reasoning	- The attempt to determine the cause of an event (or non-occurrence of an expected event).
Environment	
Natural Changes	- Changes in the features of the visual environment (both artificial and natural) that may indicate a threat.
Informational Switch	- Information in the visual environment that changes from being irrelevant to relevant that indicates potential threat, but not interpreted as threatening.
Time Pressure	- A constraint placed on processing information due to a shortened span of time in order to process that information.

Observer

Proportionality.

The first cognitive factor that mitigates decisions involves the mental representation of the occurrence (or non-occurrence) of actual events. These representations can be moderated by experiencing EOF situations. Wolfe and van Wert (2010; see also van Wert, Horowitz, & Wolfe, 2009) note that by manipulating the ratio of non-targets to targets, humans are inherently worse at detecting targets as that proportion is increased. For instance, if individuals are asked to detect 5 targets in 20, they may get all 5. However, if people are asked to detect 5 targets in 100, our detection is more likely to be worse, noting that nothing has changed about the stimuli. The same information is presented to the visual system and processed in the same manner, only the number of non-targets has been increased in the situation being perceived.

As illustrated by Wolfe and van Wert (2010), manipulating the frequency ('prevalence') of targets and non-targets in a stimulus set changes the detection rate of the target. An important finding is that by increasing the frequency of targets in a set, the false-alarms or responding that there is a cue present, when there is not, also increases. Likewise, when the target frequency is decreased, the response time increases. Thus, people attempt to compensate or react to changes in target frequency by increasing the chance to detect a cue in target-present trials by exhibiting more false alarms. People may also increase or lengthen response time in target-absent trials in order to have more time to determine whether or not there is a target present. A primary issue, is whether or not people are looking for cues that are present in target-absent trials or in target-present trials. Whether a target or potential combatant will be present in the visual environment is not necessarily information Soldiers know beforehand.

In these situations, the visual system is functioning accurately, but due to the way humans store and utilize information, particularly proportional information (for visual stimuli), humans have difficulty effectively processing that information (Wolfe & van Wert, 2010); further this information is made available via innate processing mechanisms. Increasing the frequency of non-targets increases the criterion or threshold for responding whether a target is present. Hence, there is an increase in the potential for missing targets when they are actually present. Likewise, the threshold for terminating a search also increases as the frequency of non-targets increases. When a target might be suspected, search is lengthened to allow more time for determining if a target is indeed present or not (Wolfe & van Wert, 2010). That research rehashes a major principle in signal detection theory (Green & Swets, 1966), such that varying the number of targets in a noisy stimulus set influences recognition of when targets are presented. As signals and noise vary, our brains change the representation of proportional information and by doing so adjust the decision and search thresholds to meet expectations about the world.

Moreover, the schedule of reinforcement for correct or incorrect behavior is extremely variable in the OE. In other words, the opportunity to exhibit a set of behaviors in accordance with EOF procedures may be limited by the rare opportunities to even exercise it consistently across similar situations. Further, changes to EOF procedures make it difficult to exhibit consistent behaviors. There may be many pseudo opportunities (e.g., a car feigning an approach to a control point) that do not allow the full behavior to be expressed nor fully learned. On a

standard fixed reinforcement learning schedule, a stimulus is presented a given number of times within a set period of time. But, in a dynamic OE or on a variable schedule, stimuli are presented rarely or inconsistently. Of course, the rules change concerning behavior that accompanies recognition and interpretation of potential threat indicators. Due to the rare presentation of actual targets or the lack of consistency with which Soldiers can exercise trained behavior, Soldiers have difficulty creating a stable representation of accurate proportions of target/non-target distributions. As a result, Soldiers may have difficulty reconciling goals (mission instructions) and developing causal inferences about the visual environment. The ability to make effective use of proportional information is hindered and forming a useful mental representation is difficult.

Goals (Top-down Influences).

The understanding of the structure and use of goals is a mainstay in many cognitive theories. For instance, in Anderson's Adaptive Control of Thought-Rational (ACT-R) or cognitive architecture, the addition of goal structures became a fundamental requirement for cognition (Anderson, 1983). Anderson's and other's architectures (Executive-Process/Interactive Control [EPIC] and State Operator and Result [SOAR], for example) evolved around the idea that goals are necessarily represented in the mental processing space (Anderson & Lebiere, 1998). Further, cognition was built around the idea of competing goals and the influence and utilization of information as related to goals as a means of providing purpose for cognition. The ACT-R proposes that different goals are divided into "stacks." Within each stack, sub-goals work in a last in, first out manner, such that the sub-goals most recently entering that processing space are the first processed. This processing is contended to occur for short-term (specific) and longer-term (broad) goals. In the motorcycle incident noted before, a great many details influenced goals of the responsible Soldiers and they actively engaged what appeared to be a threatening posture by potential combatants. The goal of engaging with deadly force was supported by information in the immediate environment (fast-approaching vehicles) as well as from memory (increased likelihood of attacks from insurgents on motorcycles). Further, the operational goal was to hastily recover an inoperable vehicle, not to establish a check point.

As reiterated in Vowels (2010), top-down or goal-driven processes can influence visual search by directing attention towards or away from different aspects of the environment (see also Shinoda, Hayhoe, & Shrivastava, 2001). As pointed out by Neisser and Becklen (1975), directing attention to capture particular events in the visual environment can leave other events unprocessed. Humans direct their attention towards certain objects, cues, etc., and, as a result, other elements of the visual environment are not fully processed. To understand what a Soldier is looking at and why, the goal or direction of the observation should be considered. An example is the event noted earlier involving the death of two local civilians traveling on a motorcycle at high speed towards CF (ISAF newsletter, February 2010). In this situation, information involving previous events was influencing Soldiers' recognition and interpretation, specifically that motorcycles may now be a relevant cue indicative of combatant activity. The overarching goal of their mission was to quickly recover a vehicle. Did this goal-relevant information influence the Soldiers' decision to engage with lethal force? Did top-down goals affect the processing of the visual environment? Neisser contended that perception is something we do (even if many processes necessary for perception occur unconsciously); perception is not

something external that happens to us (Neisser, 1976). Perception and cognition are active processes. In the motorcycle incident, Soldiers were combining intrinsic information with cues from the environment. As discussed in the next section, Soldiers had to make a quick determination or inference as to the intent of the civilians approaching their location.

Causal Inferences/Reasoning.

A further complicating factor in the OE is the difficulty of inferring another person's perspective without direct access to it. Applying causal reasoning for the purposes of visual threat detection is explored further in Zimmerman, Mueller, Grover, and Vowels (in preparation). Being able to infer other people's behavior is a key component to correctly interpreting potential EOF situations. Representations of proportionality and goals impact reasoning about what is or is not likely to occur. Likewise, causal inference is also affected by the absence of events (or seemingly lack of evidence), which affects proportionality and influences specific goals. If there is not a causal element present, humans may have difficulty determining the outcome of a situation. For example, if a Soldier only sees the aftermath of an IED explosion, s/he may infer many causes, some more probable than others. However, since s/he did not have a direct interaction with that visual environment when the cause was present, s/he can only infer potential antecedents. An explosion may have been caused by a group of combatants bent on inflicting harm to CF and civilians or may have been the outcome of a sectarian feud.

Wolff, Barbey, and Hausknecht, (2010) demonstrated that absence of evidence, or at least absence of causation, can also be informative; we can be adept at using information that is not present or available. In contrast, Durlach, Kring, and Bowens's (2008) research showed that stimuli in visual displays that disappear were more difficult to detect than stimuli that appear – we first have to notice the information is missing in order to utilize it. Durlach's research applied to visual interfaces, but the general dynamics of appearing/disappearing information is still relevant in real-world visual scenes (refer to Simons & Chabris, 1999). That research was focused on visual cues, but other research has focused on how reasoning occurs and what information is used to determine causality. For instance, Schustack and Sternberg (1981) found that persons used four pieces of information to determine causality. To determine causality, persons used the joint presence or absence of the possible causal event and outcome. To disconfirm causality, persons used the presence or the possible causal event and absence of the outcome or vice versa.

In an EOF situation, Soldiers may not use all four combinations of causality noted by Schustack and Sternberg but only one or two or some combination of those. For instance, Soldiers may be looking for absence of evidence that indicates the presence of a threat, such as a lack of a response or a "cold shoulder" from a normally welcoming local population. In the same situation, Soldiers may also look for further evidence to confirm suspicions, such as the presence of suspicious vehicles on their be-on-the-lookout (BOLO) lists. As with that, or any situation, Soldiers may have to rely on the integration of confirming and disconfirming evidence.

The EOF situations may involve very complex situations and information. In these instances, Soldiers are required to infer the behavior of other individuals in a variety of

operational contexts (day/night, cold/hot ambient temperatures, desolate/busy market places). However, if one is purposely concealing his/her behavior, a Soldier will be required to detect and interpret various nonverbal behaviors/cues (Yager, Strong, Roan, Matsumoto, & Metcalf, 2009; Rosenthal, et al., 2009) and/or use effective judgment (Foldes, Ferro, Vasilopulous, Cullen, Wisecarver, & Beal, 2010). Inferring causality in ambiguous situations is possible, but not foolproof; predicting the future with perfect accuracy is never possible (Taleb, 2007). Further, causal inference is also affected by events external to the observer as discussed next.

Environment

Natural changes.[7]

Natural changes are difficult to detect. For instance, Soldiers do not detect IEDs or other operational threats 100% of the time. We evolved with organisms that innately camouflage or purposefully conceal themselves from visual detection. As predator-prey relationships evolve, each counterpart jockeys to decrease/increase visual detection (Dawkins, 1976; see also Buss, 2005). Some have argued that human beings are evolved to the environments in which we evolved, not necessarily the contemporary environments in which we now live (Tooby & Cosmides, 1990b; see also Kanazawa, 2004a). These are valid contentions on many levels, but the visual environments Soldiers operate in may not be that much different from those in which our perceptual and cognitive abilities evolved, aside from artificial manipulations in urban (and rural) settings. The arguments seem at odds with our visual system's adaptive capacity to detect even minor perturbations in the visual environment. Yet Soldiers still miss manipulations of the natural environment (e.g., an emplaced IED along a roadside or a person concealing a weapon). As recounted in Vowels (2010), magicians purposely take advantage of our sensations and perceptions. Magic "tricks" work because our perceptual system is functioning just as it is supposed to. Wolfe, Reinecke, and Brawn, (2006), further note, even when participants are told the location of a change and particular attempts are not made to veil that a change is taking place; humans can still miss large and obvious changes. Just as it is difficult to take someone else's perspective, we are limited in detecting purposeful concealment; the necessary cues do not cross the threshold or are not processed in a manner that makes them threatening. Further, natural changes may not take on contextual significance and, thus, are not processed as threat cues. Even when a natural cue is noticed, it may only be processed as an expected difference within that visual environment not as an indication of threat. For instance, a herder moving his flock of sheep from one pasture to another might be noticed only as that and not for its true purpose, to act as a distracter to mask enemy movement.

Much of the training the Army currently conducts for IED detection, (e.g., FM 3-90.119, *Combined Arms Improvised Explosive Device Defeat Operations*), involves recognizing that something is out of the ordinary (e.g., a series of rocks in a roadway warning local civilians to avoid a particular route). However, for EOF situations there may be a need to rapidly change

[7]By natural, I mean natural to that particular visual landscape, which could include changes to naturally occurring elements (i.e., broken tree branches which indicate to Taliban observers that CF are in the area) and artificial elements (i.e., broken windows in a building to indicate a buried IED).

from a preventative posture to a reactive posture, which are not aided by frequent changes to SROE. In some instances of threat detection, the situation is static or the visual scene is not complex and involves the recognition of a change against a mostly non-changing visual background (see Vowels 2010). However, many EOF situations are dynamic or the situation requires the Soldier to detect important cues or changes in a visual scene that is also changing (and sometimes, very quickly). To determine if natural changes are indeed indicative of potential threats requires vigilance and an accurate mental representation of the environment. Zimmerman et al., propose that experience and/or focused training can assist Soldiers to discriminate between plausible and non-plausible changes.

Informational Switch.

Informational switch is not necessarily a change, though it can accompany a natural change. For instance, a local villager may routinely hang out his clothes to dry in the sun. However, that action could be used to inform combatants from an observation point that CF are meeting with village leaders. The information is the same, but its meaning and significance have changed. This factor is also relevant, especially since the enemy's Tactics, Techniques, and Procedures (TTPs) may change within a unit's deployment cycle and across AOs. As noted by former ISAF Afghanistan CDR, General McChrystal, our Soldiers have to understand what "normal behavior" looks like in order to effectively utilize appropriate EOF procedures (April, 2010).

Informational switch relates especially to the first cognitive factor *Proportionality*, such that, Soldiers may see hundreds of situations that: (a) do not require utilizing specific EOF procedures (just a routine interaction with local citizens) and/or (b) by using specific EOF procedures the outcome of a specific situation was positive. An important potentiality exists such that events may occur where previously irrelevant cues shift to being relevant. For instance, consider situations where the IED emplacement shifts from the use of victim-operated pressure-plates to vehicle-borne IEDs (VBIEDs). This change in IED tactic changes the relevancy, at least objectively, of different indicators or cues involving vehicles. For instance, compact cars that seem weighed down may have previously been viewed as a local citizen hauling various items by available means due to lack of other resources. That may have been perceived as typical in that particular AO. However, due the change in the IED tactic, this vehicular cue and others should become more relevant.

More relevant to assessing potential EOF situations may be the interpretation of behavior expressed by local citizens. For instance, in one particular village, inhabitants may commonly express apprehension towards CF. However, there may be a critical switch, due to the unseen arrival of Taliban fighters in the area, which changes this previously apprehensive behavior into a cue for interpretative action. A second form of informational switch comes from changes in the SROE. A Soldier's interpretation of the visual environment is further affected by what s/he is allowed to react to by affecting what are considered perceptions of hostile acts or intents (the influence of goals).

Time Pressure.

The five factors above make responding with commensurable force a challenge for Soldiers and increase the difficulty of recognizing and interpreting potential hostile acts or intent. The decisions to escalate force must be made rapidly (within seconds). According to traditional procedures, this could include the show of hand and light signals, use of flares, firing warning shots, and finally use of lethal force. Executing accurate EOF procedures may not be as difficult when pedestrians approach CF on foot but can be cumbersome and problematic if persons are approaching in a vehicle. Operating in and around the local population, likewise, exacerbates potential problems of interpretation.

Although experience is a prominent factor for many decisions that need to be made on the battlefield, some situations can arise so rapidly that even experience may not provide a quick and accurate response. Coupled with proportionality and the influence of goals, for instance, rapidly making even a 'trained' decision can be difficult. Experience can increase the likelihood of an accurate response. However, if the opportunities to actually make those decisions according to operational procedures are inconsistent, time simply spent "outside the wire" will not supplant that lack of consistency. Due to the potentially severe consequences, Soldiers may also hesitate to escalate with force in order to provide more time to increase certainty of their decision.

Time pressure is a factor in the OE and similar intense settings. As demonstrated by Bogner (1997), time pressure influences decisions in the emergency room and the operating room. Further, the influence of time pressure results not just from the primary event, the patient's state, but also from coordinating with other team members and managing an increasing cognitive workload. Other pressure comes from trying to adapt to or work around a technology that was not designed well. All of those pressures, which lead to a compacted allowance of time, are present in the OE as well. In turn, time allowed for information processing mechanisms to execute are constrained. Trying to establish a causal inference is, thus, constrained. Soldiers are impinged upon from both perceptual and cognitive factors as well as the environment itself; EOF situations can escalate very quickly and/or require Soldiers to make accurate initial interpretations and decisions in a short time.

The following model integrates these factors as the primary influences for visual threat detection and interpretation in EOF situations. It provides a structure in which these primary sources of information captured by visual attention and visual memory pathways. The model further posits how these factors can affect the integration of visual information prior to decisions to engage in EOF procedures.

Pre-decisional Space Model

None of the previous EOF models deal with the cognitive importance of the observer-environment relationship. In Gibson's theory of ecological perception, he contended that the most accurate understanding of how perception works is to view the perceiver (and act of perception) as part of an ever changing visual array of information (1979; 1986). "The act of picking up information, moreover, is a continuous act, an activity that is ceaseless and unbroken"

(Gibson, 1986, pg. 240). Moreover, focusing on the factors indicated above allows both the internal factors that influence individual (decision-making) as well as the environment from which the Soldier also retrieves information to be better understood. Though Lawlor and Lawlor (1999) did produce a model that provided more opportunities for recognizing decisional influences in EOF situations, they did not recognize cognitive factors that influence perceptions, interpretations, and decisions before a situation occurs. A fourth model is presented here that focuses on the characteristics of the Soldier as the information processing catalyst, embedded in a dynamic visual environment. This proposed model focuses on the capacities of the human observer and where training could focus to take advantage of those cognitive processes. The traditional EOF process and TAP model involve steps of what to do. The AOR provides some characteristics of what is being processed. The cognitive factors noted above are prerequisites for shaping both what is being processed and affects what to do. These elements fill in the previously missing cognitive-perceptual components that affect information processing prior to any overt behavioral decision in EOF situations.

This new perspective puts the information processing accomplished by the human observer at the fulcrum, prior to engagement in EOF procedures. What is missing from the previous models is a focus on the factors leading to interpretation. To thoroughly understand EOF situations, and how best to train for them, a crucial starting point is the cognitive behavior occurring prior to engaging in any force-graduating procedures. The model in Figure 4 attempts to provide some clarity to the primary mechanisms and primary processing pathways that affect this pre-decisional space and, thus, influence interpretation of the visual environment.

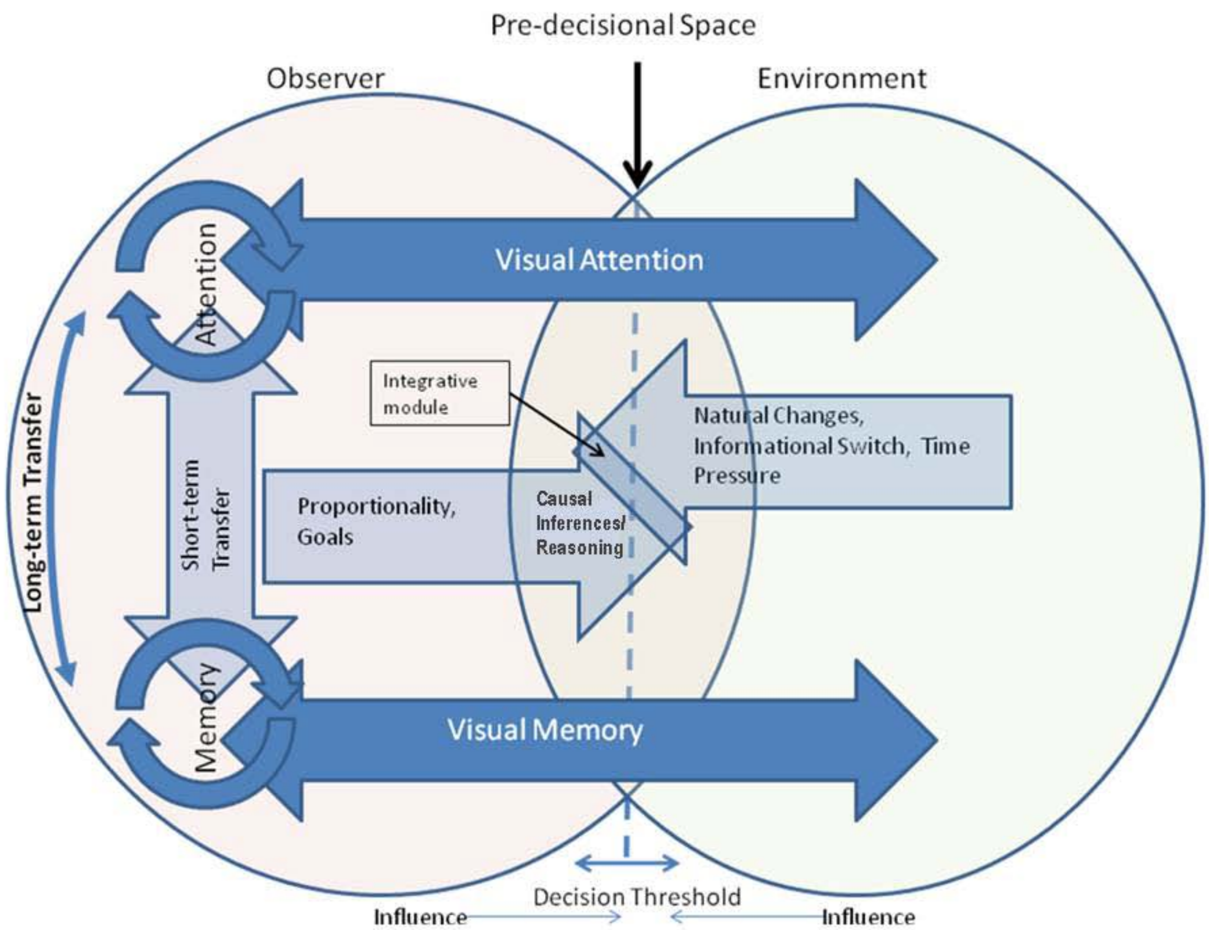

Figure 4. Pre-decisional space model depicting the independent channels of visual information acquisition and the integrative mechanisms necessary for pre-decisional information representation while demonstrating the importance of the observer-environment relationship.

The factors cited provide a more thorough understanding that processing a potential threat (person, object or situation) involves several processes that will affect interpretation. For instance, consider a situation where a Soldier has recently engaged in an escalating situation that required lethal engagement. If the situation did require escalation (e.g., the civilian was actually a combatant intent on harming CF) and the Soldier justifiably engaged with force, how will that affect his/her current information processing? This experience could influence proportionality, because certain characteristics of this recent event may be over-weighted or subjectively overvalued for some time into the future. The salient experience will affect attention and memory processes, especially if characteristics of new situations are the same or similar to what was experienced before. For instance, the EOF situation may have involved a weighted down vehicle with a single male driver refusing to stop when approaching a checkpoint. What happens next (perhaps the vehicle is weighted down with explosives) affects likelihood thresholds to react with force in future situations by lowering them. This could affect future responses, perhaps causal inferences, to that information by making them faster and Soldiers may display a more

aggressive posture to situations involving weighted down vehicles with one male occupant. Though it is possible that vehicles could also be weighted down with building materials.

The two primary information acquisition pathways important for visual threat detection are visual attention and visual memory. These are explained more thoroughly in Vowels (2010) and are only briefly reviewed here in terms of how they are affected by the cognitive factors noted above. These pathways can inform Soldiers and assist them in better understanding their visual environment concerning potential EOF situations. Visual attention and visual memory are only portions of the broader cognitive components of attention and memory, but are the primary information channels for the pre-decisional space. Proportionality, top-down influences, causal reasoning, natural change, informational switch, and time pressure influence these primary processes by making information available or not, consciously and unconsciously, resulting in either an accurate or inaccurate interpretation of the visual environment. Information is shared between these pre-decisional pathways (via short-term and long-term transfer mechanisms) and mental information representations of the cognitive factors influence the information available, and, of course, if and how it is processed.

As shown in Figure 4, the six cognitive factors are the primary informational cues deriving from the observer and the environment. All of these factors are represented mentally by the observer and require some amount of mental space (i.e., capacity). Without going into greater detail here, within the observer there are mechanisms similar to Baddeley's visuo-spatial sketchpad and phonological loop, which allows visual (and verbal) information to be represented and manipulated in active stores that can be used for current processing (Baddeley, 2000). Like Johnson-Laird's model of mental representation (1983; 2008), as a result of information processes and interactive mechanisms, representational components of the world can be established, such as proportionality. These stored "schemas" provide a structure in which to process information. Likewise, top-down goals can be formed based on the processing of the immediate visual environment but also from previous information (e.g., purpose of a mission provided by a leader). These processes in the observer lead into causal reasoning about the visual environment and allow prediction or forecasting of what events are more/less likely.

In this model, visual attention and visual memory are presented as separate processing channels. In many models, visual short-term memory (VSTM) is represented as processes and storage space that occur after initial visual processing of the immediate visual environment and from information provided by accessing long-term visual stores of information (Phillips & Baddeley, 1971). Further evidence also demonstrates access to and modification of intermediate information representations may also occur within VSTM (Delvenne, Cleeremans, & Laloyaux, 2010). Further, Sligte, Scholte, and Lamme (2009) have demonstrated a separate form of visual memory that influences VSTM. The present model proposes visual memory as a separate and concurrent visual process apart from visual attention; both processes can occur consciously and unconsciously. Although information can be filtered through typical visual attentive processes, this model allows a separate mechanism and store that delivers information both directly to active memory and to active attention via short-term transfer. This is not in contrast to attributes of VSTM models contending that VSTM is limited (e.g., Cowan, 2001). Rather, this separation of attention and memory does provide an alternative or derivative explanation as to why capacity may not result from a limitation in the number of items that can be encoded, but rather from a

lack of quality of encoded or stored representations (Palmer, 1990; see also, Palmer & Jonides, 1988). Further, the mechanisms that have to match information from these separate channels could be impeded and the resulting output would be degraded.

An active memory store can take the 'responsibility' of encoding symbolic qualities of the visual world while the visual attention channel is responsible for encoding attributes such as amount; this idea is not the same, but not dissimilar to Paivio's dual coding theory (1971), in which two discrete pathways process visual and verbal information. Quality and quantity are processed separately and then matched later to form a complete representation. Due to this separation of responsibilities for processing different features of the visual world, there is an opportunity earlier in the visual process for separate enhancement of the information captured by these channels. As noted, these matching processes could also be an alternative explanation for capacity limitation. This could be an explanation of why we might look up at a clock to get the time, only to have to look up again a few seconds later because we never effectively encoded or processed the information. If the time is 8:35, we encode the quantity, three numbers via the visual attention pathway, but not the quality or symbolic significance via visual memory. Of course, it is possible that the matching process in short-term transfer did not occur or did not execute correctly. Bialkova and Oberauer (2010), for instance, provide an argument that objects and contexts are accessed together in working memory, which could support the contention above. Different information types are encoded in the two separate visual processing pathways and matched later in short-term (or long-term) transfer. Arguments concerning interference during encoding and/or retrieval of information are not elaborated upon, but are also possible explanations for inaccurate representations of information in the pre-decisional space.

The pre-decisional space is the mental space in which we make decisions. A primary demarcation in this area of information processing is a decision threshold that can be influenced more heavily at any given point in time by cues from the environment or from information processed by the observer. For instance, visual cues from the environment may get more weight when they immediately capture attention, such as the recognition of a herder moving his flock from one pasture to another as an indicator of threat. The characteristics of the situation that are encoded and stored, although not necessarily perfectly by memory, will influence proportionality. In another example noted earlier involving a weighted down vehicle, proportional information will be affected as will future causal inferences. The more subjective value given to these factors, the more the decision threshold is affected by them.

According to Differentiation and Consolidation Theory (Svenson, 1992), decision making is an active process, although not necessarily a conscious one, and alternatives or decision options are actively altered and a decision candidate selected. An option that extends above a decision threshold is selected. This process of differentiating alternatives and the post-decision processes that execute to favor a decision candidate for future decisions is somewhat complicated in the pre-decisional space model. The decision threshold depicted in Figure 4 is an overarching threshold, and when crossed, shifts the decision maker into an action sequence (e.g., engaging in learned EOF procedures). Moreover, a differentiation and consolidation process would run for each candidate of each of the primary cognitive factors. The integrative module in the pre-decisional space works to combine these distinct candidates providing a best option overall. Of course, one candidate from of the mitigating processes could overly influence

integration (e.g., the goal of looking for certain gestures). However, this model does not preclude that some situations will be driven by salient cues nor that the capturing and integration of relevant information may occur within a matter of seconds. Nevertheless, this integration may be affected by mental representations (e.g., proportionality) resulting from previous integration and long-term storage.

All information processing takes some amount of time. Although many cognitive processes execute quickly and outside of conscious awareness, these processes do take up time and processing capacity. Whether the unconscious is limitless is debatable, but the mechanisms that transfer information between conscious and subconscious routines are not limitless, as proposed in the pre-decisional model. As a result, there is competition between informational representations that do get processed consciously and this competition is cyclical. These cyclical loops of processing are a reason researchers (e.g., Dijksterhuis) note that consciousness is of limited capacity and can be influenced by both bottom up information (e.g., attention-capturing stimuli) and top-down information (e.g., goals). That said, the processes in the pre-decisional space are not solely exercised consciously nor are they controlled only by immediate thoughts or stimulus influences from the environment; this space may also be largely influenced by processes that execute and exert influence unconsciously.

This model does not assume that information will always be encoded, stored, and retrieved accurately. Rather, it provides a framework in which necessary information processing can occur and takes into account some of the potential biases innate within the human species. Foldes et al., (2010) reference a number of biases that can affect information acquisition and use. Further, the skills (Attentiveness, Recognition, and Action) proposed in Vowels (2010) as requisite for visual threat detection are not discussed here. The model presented in this report is a cognitive framework and not a skill acquisition model. However, evidence from future research may provide impetus to test and validate the model demonstrating the attainment of those skills.

To provide an application of the pre-decisional space model, consider the motorcycle incident described earlier (pg. 4). In this case, environmental factors could have influenced interpretation, such that informational switch occurred, moving motorcycles from a commonly seen (non-threatening) object in that visual environment to a cue for potential threat. In the pre-decisional space, proportionality was influenced by information from the S2 or intelligence officer that motorcycles were likely to be used by combatants. This, likewise, affected causal inferences that motorcycles were assumed to be a more likely indicator of threat. This information led to a causal inference that the threat (i.e., the fast-approaching motorcycle) was indeed real and required action. Time pressure influenced the decision to act as well. Soldiers were attempting to recover a vehicle as quickly as possible and the motorcycles were approaching the location rapidly. The overall mission was to quickly recover a vehicle, not set up a control point. Time to process the cognitive factors in that visual environment was compacted considerably.

Training Preventative Interpretation

It is important for the Army to recognize that some behavior may not necessarily be explained by deliberate practice alone (Meinz & Hambrick, 2010). Much of conscious existence may very well be only a small piece of a large amount of information processing that occurs exclusively in the unconscious (Bargh & Chartand, 1999). Further, this information processing being autonomic, is not necessarily amenable to any form of training. Although some training can affect behavior, there are a large number of processes and mechanisms that will operate across contexts, whether certain skills have been trained or not (Buss, 2005). Many processes inherently work, unconsciously, to assist us in making sense of the world and predicting future states. The challenge is how to take advantage of our innate ability to process and interpret our internal and external world.

Consider the situation described in *Blink* (Gladwell, 2004) where the sensations and perceptions were correct, but the interpretations were not.[8] In that situation, "thin slicing" or the unconscious being able to find patterns or recognize workable solutions based on slices of experience was inaccurate and led to the worst possible outcome. We cannot always assume, as in the previous models, that interpretation of sensations and perceptions grant a veridical view of the world. A practical and viable approach is to focus on the interpretive side of such information processing. Two ongoing ARI research projects may be able to assist in modifying the conduit between unconscious processing and conscious interpretation and decision making. These two approaches, that are likely to yield useful research and training results, are discussed.

Two EOF Training Approaches: Non-Verbal Behavior (NVB) and Military Judgment Proficiency (MJP)

The ARI research has demonstrated that training on decision making can assist Soldiers in making difficult decisions (McDermott, Battaglia, Phillips, & Thordsen, 2001). Training on procedures such as EOF can assist not just the goals of MCO, but more importantly, it may assist in OOTW that promote stabilization of an area of operations (Salter, 1996).

There are three factors that need to be explored in order to properly address training preventative interpretation: (a) properly recognizing non-verbal behaviors (NVBs), (b) interpreting that information to make appropriate decisions, and (c) making a prediction about what the observed behavior means. Being able to couple the cognitive factors with tenets in the theories discussed above and test the revised model against previous models can inform necessary research. Taking this information and reviewing it along with ARI research already being conducted will greatly inform training on EOF procedures. Two lines of ARI research that could benefit training on EOF procedures involves interpreting non-verbal behavior and cues (Yager, Strong, Roan, Matsumoto, & Metcalf, 2009) and "military judgment proficiency" (MJP) or situational judgments (Foldes, et al., 2010).

[8] Refer to Chapter 6 describing the unfortunate shooting of Amadou Diallou by four off-duty law enforcement officers.

Nonverbal Behavior (NVB).

Previous ARI research has demonstrated the importance of NVB in the OE (Yager, Strong, Roan, Matsumoto, & Metcalf, 2009; Rosenthal, et al., 2009). Yager et al., found that facial expressions that were consistent in terms of predicting behavior across cultures, while "emblematic gestures" or deliberate acts, were often carried out unconsciously, and often to conceal deceptive emotional states. Yager et al., propose several topics important for teaching NVB including: scene scanning, detection of change, aggression, deception, and cues decodable at distances (20 feet or more). The NVB curriculum proposed as a result of that research includes, decoding facial expressions, understanding gestures and their use, and detecting change in scenes and persons.

Further, ARI research has shown that training in a context such as negotiations would provide a relevant setting for Soldiers as they often need these skills in the operational environment (Rosenthal et al., 2009). The recommendations by Rosenthal et al., include four primary factors when considering a training program for accurate non-verbal cue (NVC) interpretation:

- setting (e.g., realistic situations in which Soldiers are asked to achieve a successful negotiated outcome),
- the training stimuli (e.g., video segments using actors or Iraqi citizens),
- the response format and scoring, and
- practice and feedback.

The format recommended by Rosenthal et al., was vignettes which provide an understanding of important contextual factors and characteristics of people from the culture of interest. Likewise, the vignettes could take the form of video of recorded citizens from the other culture of interest to increase relevance and accuracy of the nonverbal behavior.

The EOF situations can involve correctly interpreting NVCs and may hinge upon the correct, initial understanding of what cues individuals in a local population are exhibiting. This is especially important as many situations may involve interpretation of NVCs at a distance or within a noisy (auditory and visual) environment. Increasing the accuracy of initial analysis of NVCs could lead to de-escalating situations before they unnecessarily escalate. In turn, successful civilian-Soldier interactions strengthen relations between a local population and the units operating in that AO (Fite, Breidert, & Shadrick, 2009). Reactions to and assessment of NVCs may be difficult for an individual relying on that information to express, but a systematic assessment of recalled nonverbal behaviors may prove invaluable. Consider an example in Gigerenzer (2008) involving the quick evaluation of potential drug couriers by undercover law enforcement officers. The officers were able to rapidly evaluate people, but were unable to describe what they were looking for or how they processed the necessary cues/information.

Military Judgment Proficiency (MJP).

Using support from prominent theoretical models of judgment and decision making (JDM), Foldes, et al., (2010) proposed military judgment proficiency (MJP) as a skill involving

several factors that guide JDM in the operational environment, especially those that are complex (e.g., “novel, ambiguous, and rapidly changing”). It was argued to consist of four primary factors: (a) accurately framing decision problems, (b) detecting and interpreting important situational factors/cues, (c) forecasting the consequences, and (d) choosing an effective course of action based on the preceding three factors.

They recognize the contentions that expertise is largely a function of well-organized information representation whose outputs take the form of (past) problem solutions and these can be accessed more readily than novices. This partly results from novices not having the amount nor variety of experiences nor having the information organized in such an accessible manner. Foldes, et al., however, do not discount heuristics, because they are also a functional part of JDM, especially in complex decision environments. They argue that cognitive heuristics are more likely to effectively guide JDM in those environments, although more analytical processes could be utilized. However, the more deliberate analysis may serve mostly as a ‘check’ on initial information processing (see also Ariely, 2008 and Gigerenzer, 2008).

Foldes et al., argues that using a situation judgment test (SJT) can efficiently assess differences among Soldiers on MJP. The results of this assessment instrument can be used in the selection of Soldiers for particular jobs. Further, it could be used to focus training on the different aspects of MJP that may be lacking. The SJTs are based closely on real situations and have been used to assess a variety of constructs including problem solving and decision-making (Beal, 2007) and to training leadership (Hill et al., 2008).

Research and training on MJP could benefit training on EOF as both involve similar skills such as accurately framing a decision problem. How an EOF situation is initially framed and interpreted is likely to serve as the critical point before a decision is ever made, recognizing that critical point can be impacted by the cognitive factors discussed earlier. Likewise, research and training involving the decoding and utilization of non-verbal information could benefit training on EOF situations by providing specific training objectives based on sound psychological research.

Training Impact on the Pre-decisional Space Model

Training on NVB and MJP would fit well with the proposed model such that the revised model deals with the pre-decisional space and the factors that affect potential decisions before they are made. The argument presented is that previous models of EOF have neglected the processes and decisions that need to occur before movement into escalation occurs and that training on NVB and MJP would affect this pre-decisional space by influencing recognition, interpretation, and prediction of observed behavior in the visual environment.

Nonverbal Behavior (NVB) Impact.

Yager, et al., 2009 and Rosenthal, et al., 2009 demonstrated that several forms of detection (change, aggression, and deception) are important skills to develop related to NVB. NVB is particularly important for EOF situations, because those cues can inform Soldiers of whether a potential threat is present. An example of the impact of NVB training on the pre-

decisional space model would be to direct the visual attention and visual memory pathways to attend to and recognize more relevant information from the visual environment. For instance, if the goal is to detect change in people (e.g., change in facial expression of local children) in the visual environment, that goal will drive the observer to look for NVB cues to determine attitude towards CF operating in the area. Change in expression from welcoming to less cordial could indicate presence of enemy combatants in the area.

Military Judgment Proficiency (MJP) Impact.

Foldes et al., (2010) contend that an important component of MJP is forecasting different courses of action. Training on MJP could directly affect the pre-decisional space model by affecting causal reasoning. Sufficiently training Soldiers to explore alternatives the enemy may be considering, such as the terrain and the resources available to them, could inform how relevant situational cues are recognized and used to make determinations of causation. Training Soldiers to use causal inferences about what might cause a situation to occur, such as a complex attack (e.g., involving and IED explosion followed by small arms fire) could improve overall judgment across a variety of situations. Another component of MJP is to effectively frame the decision problem and to detect important changes in the environment. Training on framing and detection might impact Soldiers' ability to pick up on changes involving switches in information. For instance, if a Soldier is trained to frame the decision environment as dynamic or one that fluctuates as a result of constantly shifting variables, informational switches may become more relevant.

Schema theory (Anderson, Reynolds, Schaller, & Goetz, 1977; see also Piaget, 1972) holds that the world can be represented and information processed within stored thematic frameworks. Training on what cues to look for and how to use that information to make informed judgments would positively affect performance in EOF situations. Training involving vignettes requiring situational judgments would provide a stable background upon which to retrieve previous experiences and could serve as episodic templates upon which to test the current visual environment. The NVB training could direct both visual attention and visual memory processes in order to acquire the cues that would provide the most relevant information for further processing. The pre-decisional space model takes into account long-term transfer. A primary function of that process is to develop general, mental frameworks in which to process mental representations of observer and environmental cues. This contention does not ignore the fact that stored representations could be incomplete or inaccurate and that, in turn, guidance of visual processes could lead to false impressions of the visual environment. Likewise, observer and environmental factors previously noted could negatively influence processing of the visual environment when environmental stimuli overpower attention and memory processes, for instance. However, the model presented includes testable premises and the theories cited below provide further avenues of psychological inquiry.

Future Research: Further Theoretical Considerations

Though none of the theories noted previously are necessarily a standalone framework, pieces of each could be used to further explore the characteristics important to EOF behavior. The following discussion is a brief examination of a few theoretical considerations that would

provide further useful information about visual threat detection and EOF, in addition to those provided for threat detection in Vowels (2010). The three theories reviewed here serve as broad frameworks for better understanding the six cognitive factors (and potential others) in EOF situations.

As noted in Lawlor and Lawlor (1999), there is an extensive amount of published work that assesses law enforcement officers' decisions to engage with deadly force (or not) in escalating situations. Their recommendation is seconded here in that an analysis at the individual (personal) level of Soldiers for negative and positive outcomes would provide great insights into this decision process, particularly for cognitive factors.

The three theoretical considerations, from unconscious thought theory to construal level theory are discussed sequentially. The principles in each theory could clarify information processing pathways of the pre-decisional space model and exploring the contentions of conscious and unconscious processing.

Unconscious Thought Theory

The integration of cues from the observer and the environment make the pre-decisional space model a useful framework to consider for situations of potential escalation. These processes are executing and delivering cyclical output largely outside of conscious awareness. This makes Marcel's (1983) and Jacoby's (1991) foundational research on unconscious processing and the interaction of conscious and unconscious processes integral to understanding how visual threat detection works.

A further contention worth exploring in reference to conscious and unconscious processing is whether humans can process all choice set combinations in complex situations at the unconscious level. Simon's (1957) and Gigerenzer's (2008) research illustrated limitations on processing at the conscious level for humans and also at the unconscious level. Further, it has been suggested that information restraints at the conscious level may not be present at an unconscious level or that difficult decisions can be facilitated at the unconscious level due to a lack of processing constraint (Dijksterhuis & Nordgren, 2006).

Researchers have explored the function of the unconscious in decision-making and whether it is better to rely on conscious or unconscious information processing for complex decisions (Dijksterhuis, Bos, van der Leij, & Baaren, 2009). Much of previous research in the judgment and decision-making literature has assumed that decisions were made through conscious and controlled effort or relying on learned biases. However, this notion has been challenged with the systematic review of situations illustrating that reliance on the unconscious may sometimes be more beneficial than conscious processes (Dijksterhuis & Nordgren, 2006).

Results of that research has implications for training what might be termed intuitive decision-making. The Recognition Primed Decision-Making (RPDM) model rests upon the idea that repeated exposure to situations allows people to store and adaptively associate those (new) experiences with past experiences and develop a trained skill or framework in which to see the world (Klein, 1998). Rather than going through a probability analysis of potential event

outcomes, people go through a pattern matching process. This process is rapid and results in an 'intuitive' and accurate response to a situation. However, the measure of effort and resource allocation in regard to unconscious decision-making remains to be determined within that theory.

Bargh and Chartrand (1999; see also Stanovich, 2004) have reiterated the notion that the majority of our everyday experiences is a result of unconscious processing. An idea left unturned is how much effort that unconscious processing requires; the suggestion is that the processing is 'effortless.' However, Dijksterhuis' research suggests that certain decisions are better relied on through unconscious processing and that outcomes for those decisions are not immediate, which suggests an effort requirement not commonly associated with intuitive responses (or unconscious processing).

Many decisions have to be made in a limited time frame and complete reliance on the unconscious or time to brood over options is not always possible. Dijksterhuis et al., propose that unconscious decision-making is effectively utilized more by expert decision makers. As shown in Figure 5, experts may also be more able to rely on unconscious information processing in order to predict potential future states of the world. Although the development of expertise may be lengthy, knowing when to rely on the unconscious and how to develop and hone that skill quicker would be helpful for decision makers at any level of development.

One of the major tenets of Unconscious Thought Theory (UTT) is that attention segregates conscious from unconscious thought. A major processing pathway of the pre-decisional space model is visual attention. However, the model assumes that attention involves conscious and unconscious processing. Another major contention of UTT is that experts make better use of unconscious resources than novices. Future research could examine whether the proposed cognitive framework could serve as a skill acquisition model and clarify how development of expertise occurs for visual threat detection (at conscious and unconscious levels).

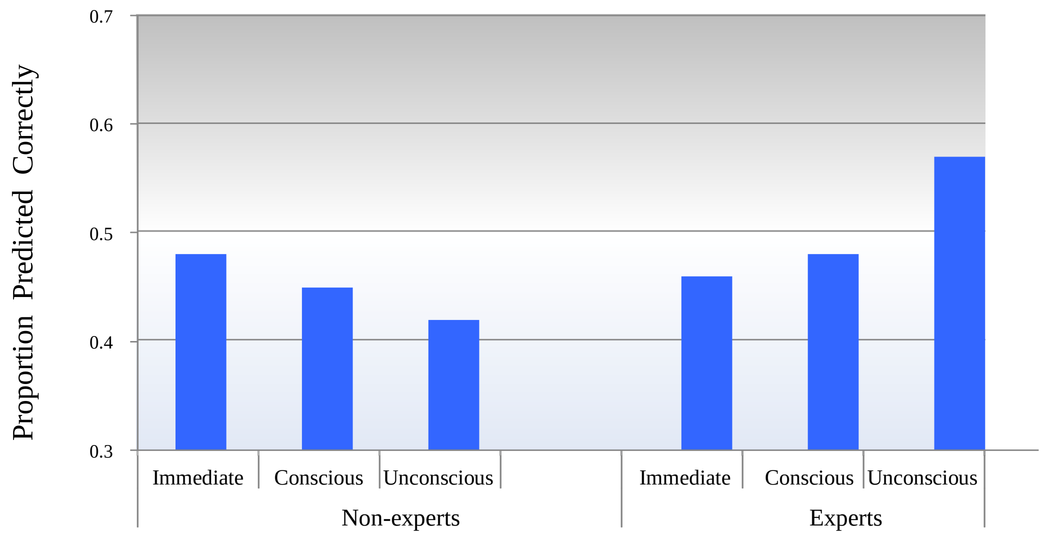

Figure 5. Indication that unconscious processing is utilized more efficiently by experts than non-experts in an experiment involving predicting soccer match outcomes. Adapted from Dijksterhuis et al., (2009, pg. 3).

Information Integration Theory

Anderson proposed Information Integration Theory (IIT) to explain how multiple perceptions and cognitions can be integrated into a unique, whole understanding of the world (Anderson, 1981). A principle underlying the axiom of "purposiveness," is that the majority of information processing is unconscious (Anderson, 1996). The majority of learning about the world, particularly the probability of occurrence of events, and expectancy of their occurrence, is possible through an integrative process. Anderson did, however, provide an algebraic scaffolding to assimilate new information with existing background knowledge, termed assemblage, usually occurring within 'operating memory.'

From a research perspective, it is a functional framework as it attempts to address gaps in both cognition and decision-making. This theory also provides a practical application as it includes mechanisms for integrating multiple sources of information with varying weights of importance, much like an EOF situation. As an example of its applicability, IIT address memory formation and forecasting, both needed for EOF situations. In one process, similarities of present information items are coupled with those of stored representations in the form of memory traces. Anderson (1996) further notes that 'discriminability' will be degraded when the previous and newer items are congruent. Concomitantly, however, familiarity increases for the old and new congruent items because they are similar to the item activated by expectation. For non-congruent items, discriminability is mostly unchanged and familiarity actually decreases. The reason for the disparity results from the fact that old and new items have a low similarity to expectation.

Though much of Anderson's work focused on attitude formation, IIT may also be applicable to research involving EOF. For instance, combatants in a particular AO may switch TTPs and begin approaching CF on motorcycles instead of in vehicles or on foot. When first arriving in the AO, a unit might be exposed primarily to cars or persons on foot testing the limitations and reactions of CF. The visual indicators of potential threats are different and require a shift in both the perceptual and conceptual processes for detecting these distinct situations. Anderson's theory allows a model in order to test the integration of new and old information.

The pre-decisional space model contends that information from the visual environment is processed via separate visual attention and visual memory processing pathways. This information is joined in an integrative module in the pre-decisional space. There is also the opportunity to share information in long-term transfer. The IIT contends that information is integrated using a mental algebraic framework and this assimilation can be assessed using contentions of mathematical theory. At least, the integrative contentions of the pre-decisional space model could be assessed using the structure provided in IIT by using the mathematical underpinnings to assess how different attributes of cues in the visual environment are successfully integrated (or not).

Construal Level Theory

In this theory, information is construed or depicted as psychological distances. Rudimentarily, if an event in the distant future is considered, then it is construed at a high or abstract level and information concerning that event or item is processed to fit that construal. Likewise, if an event or item is considered closer to present time, then the event or item is represented at a less abstract level and information relating to that event or item is processed in such a manner (Liberman & Trope, 1998; Trope & Liberman, 2010). For instance, Liberman and Trope demonstrated that information about super ordinate goals or higher level, such as the *why* of a future event, had a strong impact on decisions involving future events. However, information involving subordinate goals, such as how something would get accomplished, had greatest influence on decisions for the near future.

This theory could, likewise, influence learning about the environment. This could directly influence training such that assessing situations in terms of close or distant proximity to the current space and time could differently train skills necessary for appropriately interpreting situations that could require EOF procedures. Training NVB and MJP could potentially benefit from a framework such as that proposed in construal level theory because it involves both evaluation and prediction (Liberman & Trope, 2010).

Another major area of research directly applicable to EOF situations is forecasting. As an example, for the current discussion, Soldiers processing EOF events and cues within that event will do so differently according to how they construe the information, in terms of distance to now or the future. In many instances, humans are decidedly bad at forecasting, whether certain events will occur, but especially when it comes to intentions of others (Ariely, 2008). This is particularly troubling since one of the main skills required to correctly carry out EOF procedures is to quickly forecast the intentions of others in the immediate visual environment

(CALL, 2007; 2009). A question for Soldiers performing such procedures is whether to err on the side of precaution or to be more aggressive in their approach to individuals within the immediate environment. On one side, the bigger picture of winning the hearts and minds of the local populace is at stake, and on the other is a potential debilitation or restriction of trained Soldiers to execute their procedures effectively. Recent research, however, has shown that attention can be oriented to the past or future or towards left or right in the spatio-temporal space (Ouellet, Santiago, Funes, & Lupianez, 2010). This is relevant for EOF situations, because it implies that Soldiers that orient towards the future might benefit in being able to predict what might occur in the OE.

Construal level theory assumes that a principal component of cognitive processing is set within a structure of psychological distance. In the manner the pre-decisional space model is presently construed, there is no argument involving psychological distance, only mental space capacity and time capacity to process information. However, the pre-decisional space model is proposed to demonstrate psychological processing that occurs prior to engaging in EOF procedures. The output from that processing can be used to predict potential actions of persons or objects in the environment. Psychological distance allows persons to orient information processing to evaluate and predict current and future states of the world. Orienting information to be processed at different levels of abstraction (based on psychological distance) could refine the information processing pathways and clarify the necessary attention and memory processes.

Summary and Conclusions

Escalation of Force is an important topic and Soldiers' understanding and effective implementation of EOF procedures is often requisite for successful operations. The purpose of this report was to examine this issue that has been, and will continue to be, a major topic especially relevant for Soldiers and leaders that are conducting operations within and around a civilian population. Conducting missions around civilians increases the opportunity for negative outcomes such as violations of EOF. As indicated in this document, further research involving when and how Soldiers utilize EOF procedures is warranted.

In sum, at the level of the individual decision maker, there is inherent difficulty in training Soldiers to initially conduct combat maneuvers and to then follow those maneuvers with peacekeeping operations all while engaging potential threats imbedded among the civilian populace. It is recommended that time be added and emphasis placed on more thoroughly training the proposed balanced approach (ref. ISAF guidance) earlier and continuously throughout Soldiers' careers; especially to Soldiers who will actively engage in operations in and around local populations.

The pre-decisional space model is a means for assessing the impact of several cognitive factors prior to an escalation of force. It is proposed to go beyond previous models (Traditional, TAP, AOR) by focusing on the importance of multiple sources of information in order to aid processes of recognition and interpretation. Based on the components of the proposed model, two approaches explored in ARI research are recommended for training purposes: nonverbal behavior and military judgment proficiency. Further research, is needed to test the pre-decisional space model against the tenets of current theories (UTT, IIT, Construal Level Theory

[CLT]) that also address the need to better understand information integrative processes, how visual information is stored for long-term use, and how various information sources are used to make predictions.

Given the trends of the current two theaters of operation, CF have improved in their ability to detect IEDs and there have been some commendable efforts examining IED use and their effects (e.g., Barker, 2010). However, very little has been reported involving the same quality of examination on EOF events (with negative and positive outcomes). Typically, only when there is an incident potentially concerning a mishap involving local civilians, does there seem to be a more thorough consideration of EOF and only as an acute reaction for that particular incident (Mestrovic, 2008).

The model proposed provides an approach to systematically examine the cognitive-perceptual impact of several factors prior to decisions to escalate with force in a variety of situations. By further exploring the psychological factors that impact these decisions, situations can be more fully understood from research and training perspectives. As a result of this research effort, training can be improved in order to enhance Soldier performance. Training, based on psychologically grounded research that incorporates how visual information in the operational environment is recognized, interpreted, and utilized to make decisions, increases Soldier performance, adaptability, and survival in EOF situations.

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Appendix A

Acronyms

ACT-R	Adaptive Control of Thought-Rational
AO	Area of Operations
AOR	Ability, Opportunity, Risk of Serious Injury
ARI	U.S. Army Research Institute for the Behavioral and Social Sciences
BCT	Brigade Combat Team
BOLO	Be-on-the-Lookout
CALL	Center for Army Lessons Learned
CDR	Commander
CF	Coalition Forces
CLT	Construal Level Theory
COIN	Counterinsurgency
DoD	Department of Defense
EOF	Escalation of Force
EPIC	Executive-Process/Interactive Control
FM	Field Manual
IED	Improvised Explosive Device
IIT	Information Integration Theory
ISAF	International Security Assistance Force
JDM	Judgment and Decision-Making
MCO	Major Combat Operations
MJP	Military Judgment Proficiency
NVB	Non-verbal Behavior
NVC	Non-verbal Cue
OE	Operational Environment
OOTW	Operations Other Than War
PID	Positive Identification
ROE	Rules of Engagement
RPDM	Recognition-Primed Decision Making model

(S)ROE	(Standing) Rules of Engagement
SJT	Situation Judgment Test
SOAR	State Operator and Result
TAP	Threat Assessment Process model
TTP	Tactics, Techniques, and Procedures
UTT	Unconscious Thought Theory
VBIED	Vehicle-Borne Improvised Explosive Device
VCP	Vehicle Control Point
VSTM	Visual Short-term Memory